Meteorological Support for INTEX-NA

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Mission Meteorologist--Prof. Fuelberg will be Mission Meteorologist during INTEX-NA. He will be responsible for meteorological forecasting during flight operations and for providing input on the origins and destinations of air parcels encountered during the flights. He will consult with meteorologists at the National Weather Service and with meteorologists who will participate in INTEX and ICARTT. Three Florida State University (FSU) graduate students will assist with the project—Chris Kiley, Danielle Morse, and Mike Porter.

An important task of the mission meteorologist is to prepare standard surface and en-route weather forecasts. Major portions of the United States have a climatological maximum of thunderstorm activity during the INTEX-NA period, and some of the thunderstorms become severe. We will forecast the locations and timing of these thunderstorms so the DC-8 can safely sample their effects.

Backward Trajectory Calculations--We will prepare backward trajectories that arrive along the proposed flight tracks. The origins and paths of these trajectories describe the meteorological history of air that would be encountered along a proposed flight track. For each flight day we will prepare a database of 10 day back trajectories using gridded data from the National Weather Service (NWS) Global Forecast System (GFS) which includes a global spectral model. GFS analyses are available at 6 hourly intervals, at 1.0 deg. lat/lon horizontal resolution, and at 64 vertical levels. GFS forecasts are available at 3 hourly intervals.

The trajectories will be created on a 1 x 1 deg lat/lon grid covering the United States and will begin at a number of different pressure levels. We will use the kinematic method to calculate trajectories, i.e., employing horizontal and vertical wind components for the calculations, and not invoking the isentropic assumption. The FSU trajectory model recently was upgraded to include improved numerical techniques. It has been used in all of the previous GTE missions in which FSU has participated. On a given day, several flight tracks likely will be considered. When we specify the grid points that define each flight, the corresponding trajectories will be accessed from the data set described above and then plotted. Both horizontal and altitude plots will be created for each flight being considered.

Forward Trajectories from Lightning--We will collect data from the National Lightning Detection Network (NLDN) in real time, provided by NASA-MSFC. Spatial maps of the lightning will reveal where thunderstorms have occurred. Then, we will

calculate forward trajectories from those lightning locations at the altitudes where convective outflow has been documented in the literature, typically 400, 300, and 200 hPa. These trajectories will provide guidance on where the DC-8 can intercept convectively influenced air. This activity will be collaborated with Drs. Jim Crawford and Ken Pickering.

Boundary Layer Exposure Product--We have developed a procedure to locate air that previously has been in the planetary boundary layer (PBL)—the source of most pollution. That development constituted part of the Ph.D. dissertation research for graduate student Chris Kiley. The procedure utilizes 10 day backward trajectories calculated from the GFS meteorological data (described above), as well as GFS-derived PBL heights. Specifically, the scheme compares the heights of backward trajectories beginning at several pressure levels (e.g., 850, 700, 500, 400 and 300 hPa) with the heights of the PBL. Output consists of maps of several different parameters—time that each trajectory spent in the PBL, time since being in the PBL, and the local CO emissions while in the PBL. The maps will be prepared using a reverse domain filling technique and will indicate those locations where the DC-8 could fly to encounter previously boundary layer air at different flight levels.

During INTEX-A we will run the newly developed procedure in real time using data from the GFS meteorological model as input. After the field phase is completed we will re-run the scheme to include any updated meteorological data that become available.

Post-Mission Meteorological Products--Meteorological products such as streamlines, trajectories, etc. are vital ingredients for understanding the chemical signatures that are sampled in the field. The various products that we create for flight planning (described above) will be made with combinations of forecast and initial meteorological data from the NWS. However, final meteorological data sets that are produced later by them contain observations that came in "late," and were not included initially. In addition, the actual flights of the DC-8 will be different from those that were considered during flight planning. These final data will be used to prepare our final trajectory products for use by the Science Team.